

# Price Indicator for Live Cattle Contracts in

Futures Trading

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## **Resumo**

*Discute-se questões teóricas sobre a liquidação financeira pura de contratos futuros na agricultura, apresentando a inovação financeira de criação de um indicador de preços (20 anos de trajetória) para bovinos vivos utilizados para liquidação de contratos negociados na BM & F de derivativos de câmbio do Brasil, e realizar testes empíricos.*

## **Abstract**

*Discuss theoretical issues about pure financial settlement of future contracts in agriculture, presenting the financial innovation of creating a price indicator (20 years track record) for live cattle used for settlement of contracts traded in Brazil's BM&F Derivative Exchange, and perform empirical tests.*

## Introduction

**W**e intend in this paper to present the Brazilian experience with the use of price indicators for financial settlement of live cattle future contracts, as well as to discuss the theoretical issues about pure financial settlement of agricultural contracts (and the possible problems faced regarding convergence of futures and spot prices as the settlement day approaches)<sup>1</sup>. We will describe the concept and creation of the Price Indicator and show the methodology used (daily survey with representative buyers and sellers in several regions of the country)<sup>2</sup>. Finally, we will perform the econometric/statistical tests (like co integration and others) to check the consistency and adequacy of the Price Indicator intending to be representative of cattle prices for the whole of Brazil<sup>3</sup>.

The main contribution of the paper is to highlight the difficulties for a developing country to obtain sustainable business on a futures contract traded in the exchange, and how, sometimes, it is necessary to be innovative in the design of the contract in order to overcome the infrastructure bottlenecks and the institutional constraints of the market place.

## Background

The Federative Republic of Brazil is the largest country in South America. It has 26 states, a population of almost 200 million and

*1 A standard Livestock futures contract used by the derivatives exchanges is a legally binding agreement for a buyer to accept delivery and a seller to make delivery of:*

- a standardized quantity and quality of a specified livestock product, like live cattle,
- during a standardized time period,
- to a standardized delivery point,
- for a price negotiated at the Derivative Exchange (BM&F), on either the electronic trading platform or via open outcry on the trading floor.

*2 The innovation of BM&F was to avoid the need for physical delivery, to develop an appropriate price indicator and to introduce a purely financial settlement for the contract.*

*3 I would like to thank the important collaboration of Geraldo Barros, Sergio de Zen, Thiago Carvalho and Shirley Menezes of CEPEA/ESALQ.*

GDP (2013) of USD2.4 trillion. The Brazilian economy has grown consistently in recent years, with inflation kept under control. The country adopted an inflation target system in 1999 and has implemented, since that time, monetary and fiscal policies that support growth (without putting excessive pressure on prices). Brazil was one of the first countries to recover from the 2008 crisis; consumption and investment were already back to normal in the following years, and GDP growth has been modest but positive since then.

A noteworthy aspect of the Brazilian economy is that the country is a leading producer and exporter of agricultural and mineral commodities<sup>4</sup>. Brazil is the country with the largest herd of cattle in the world, more than 200 million heads. It is also the world's largest exporter of cattle meat. The cattle meat business became today a modern and competitive industry in Brazil, and supplies both for the domestic and the foreign markets. The location of cattle ranching is widely spread in the country, which has a territorial extension of 3.27 million square miles<sup>5</sup>. An important aspect of market trends is that livestock buyers and sellers are facing an ever increasing level of price risk, for which futures contracts are a good hedging instrument.

Brazil has a highly developed capital market with the largest Exchange in Latin America, whose main players are major multinational financial institutions and robust local institutions. It also has the most diversified and advanced derivatives exchange among the developing countries, BM&F Bovespa, which offers a complete organization for market players to manage

*4 The world producer and exporter rankings, according to USDA, place Brazil in the following positions: Beef 1<sup>st</sup>, 1<sup>st</sup>; Coffee 1<sup>st</sup>, 1<sup>st</sup>; Cotton 2<sup>nd</sup>, 1<sup>st</sup>; Ethanol 2<sup>nd</sup>, 1<sup>st</sup>; Iron ore 2<sup>nd</sup>, 1<sup>st</sup>; Live cattle 1<sup>st</sup>, 1<sup>st</sup>; Orange juice 3<sup>rd</sup>, 1<sup>st</sup>; Poultry 2<sup>nd</sup>, 1<sup>st</sup>; Soybean 5<sup>th</sup>, 4<sup>th</sup>; Sugar 1<sup>st</sup>, 1<sup>st</sup>; Source: USDA.*

*5 Brazil's territory makes it the fifth-largest country of the world, surpassed only by Russia, Canada, China and the United States. Its territory covers 47 percent of South America.*

the risk of price volatility in the cattle market<sup>6</sup>. There has been constant evolution in trading volumes and liquidity in the equities and derivatives segments, with heavy participation from foreign investors.

## The Role of the Exchange

The derivatives markets (forward, futures, options, and swaps) are gaining a growing importance in the Brazilian economy, repeating a phenomenon that happened in some of the most important market economies of the world. A commodities exchange dealing with a whole set of financial instruments – that is, going beyond the spot and physical markets and becoming apt for trading derivatives - may be regarded as an organization based on management models and norms of conduct and performance, which offers services for trading, hedging and price discovery.

Most mature economies, like the United States, evolved from the trading of forward contracts to the trading of derivatives contracts. Developing countries like Brazil are jumping from cash markets to futures markets in commodities. They face several problems, most of them deriving from the weak institutional basis of laws, customs, organization, and reputation.

We have to consider that, in addition to all relevant factors applied to advanced countries, developing countries have to organize the production chain of the business, and engage efforts in the areas of learning, innovation, technology, and institutional development. Thus, it is necessary, in order to launch a new futures contract, to organize some of the downstream segments of the production chain of the business.

It is also important to understand that an exchange has an important, but limited, role for developing markets. An exchange, like BM&F

<sup>6</sup> The BM&F Bovespa ranks among the top eight derivative exchanges of the world, measured by the number of contracts traded in 2013.

Bovespa, creates the organization facilities for transactions. The prices, however, are not set by the exchange, but by the sellers and buyers themselves. The Exchange uses people, capital and other resources to provide the marketplace, futures products, technology, rules and regulations for the buyers and sellers to come together.

Before the Exchange offers the contract in the market, it is necessary “to create the market”. In other words, derivative exchanges in developing countries, like BM&F Bovespa, have to offer services and organize sections of the production chain of the commodity; otherwise, the contract will not attract liquidity.

The exchange specialized in futures is a marketplace to trade contracts. A futures contract is a legally binding agreement, enforceable as a written contract, and protected by the law. A standard futures contract for live cattle, in general, contains specifications to match cash market commodities and industry standards. The specifications help to ensure that there is a two-way relationship between the benchmark livestock futures market and the numerous livestock cash markets in all regions of the country<sup>7</sup>.

The live cattle futures contract of BM&F Bovespa presents the following major items:

Title: Live Cattle Futures

Ticker symbol: BGI

Tick size: BRL0.01 per net arroba (15 kilograms)

Underlying asset: Up to 42 month-old, male, castrated live cattle finished-weight

<sup>7</sup> BM&F constantly monitors industry standards and cash market practices. If there are significant changes, the Exchange will consult with market participants to determine if modifications to the futures contract specifications are necessary. BM&F Bovespa has a permanent consultancy house organ, called the “The Chamber of Cattle”, to monitor the specifications of the contract with regard to changes in the market.

(convex carcass) for slaughter, well finished in pasture or under confinement, ranging from the minimum of 450 kilograms to the maximum of 550 kilograms<sup>8</sup>

Price quotation: BRL per net arroba

Contract size: 330 net arrobas (1 net arroba = 15 kilograms)

Last trading day: Last business day of the delivery month

Delivery months: All months

Price Indicator of Live Cattle: IBOI-GORDO<sub>t</sub> (shown in Reais per net arroba, calculated by a recognized price collection and calculation institution, defined by Exchange norms, and published through the electronic address of the Exchange)<sup>9</sup>

Financial Settlement: uses the Price Indicator

Price is the only negotiable element of a futures contract. Price discovery and transparency are the major contributions for the market made by the Exchange. The trade of futures contracts depends on the interaction between the buyer and the seller, representing demand and supply, respectively. A futures market price is determined through the interaction of the buyers' bids (demand) and the sellers' offers (supply)<sup>10</sup>. The price discovered in a futures market results from this interaction. There is also an interaction between cash markets and futures markets.

The cash market in the cattle industry in

8 "Bovinos machos, com 16 (dezesseis) arrobas líquidas ou mais de carcaça e idade máxima de 42 (quarenta e dois) meses".

9 "Indicador de Preço Disponível do Boi Gordo BM&FBOVESPA, expresso em reais por arroba líquida, apurado por instituição renomada em coleta de preços, definida em Ofício Circular, e divulgada no endereço eletrônico da Bolsa"

10 For example, supposing hedging is the motivation behind the trade, a livestock producer using futures could obtain downside price protection, and, conversely, a livestock buyer could obtain upside price protection.

Brazil is quite large and broad<sup>11</sup>. There are several specific market locations spread over the country in which the exchange of a physical product, for payment, takes place. Cash markets are the locations where the hedger regularly buys or sells the physical livestock products. The hedger only needs to be concerned with its local cash market and has just one basis to monitor<sup>12</sup>.

Cash market prices may differ depending on where they are formed and the local circumstances, since cattle ranches operate in all states and regions of Brazil, transportation costs are high, and cattle heads are mainly raised in open pastures (and very sensitive to the rainfall and regional weather changes)<sup>13</sup>. In addition, we have both European cattle (bos Taurus) and Asian cattle (bos Indicus), that command different unit prices since quality of meat varies<sup>14</sup>.

A futures market is a centralized market place, organized by BM&F<sup>15</sup>. It is important to notice that in this market the price set in the Exchange is the same for buyers and sellers, regardless of the type of trader – hedger or speculator – they are or where they are located<sup>16</sup>. The basis for distinction is that futures markets participants act either managing price risk, or assuming price risk.

11 The cash market sometimes receive the names "physical" or "underlying" markets.

12 If the hedgers have more than one local cash market that they regularly buy livestock from or sell to, then they will have more than one basis to monitor. Note that basis is the relationship between a cash market price and a futures contract price, and it reflects the correlation of the hedger's local cash market to the futures market. The better the correlation between the two markets, the more effective the hedge strategy will be.

13 Brazil is a sub-continent, and we have equatorial climate in the North, tropical climate in the Center, and sub-tropical and temperate climate in the South.

14 The most common type of cattle in Brazil is the "Nelore", which originally was imported from India, but suffered an extraordinary change in Brazil due to introduction of genetic experiments. The modifications were made through time in Brazil, prompted by the drive to adapt the cattle to changes in consumer preferences and commercial forces in the domestic and export markets demanding certain types of meat.

15 The futures market, sometimes, is described as being a "benchmark" market.

16 In truth, there is an element of speculation in the hedger behavior, and an element of investment in the speculator behavior.

A hedger is an individual or firm that uses the futures market to manage or reduce the price risk associated with their cash market position. The speculator is an individual or firm that assumes price risk by buying or selling livestock futures in an attempt to profit from a potential change in price or price relationship<sup>17</sup>.

The futures industry uses some terms to describe the interplay of participants in the market. A bid is an expression to buy and represents the demand for a product. An offer is an expression to sell and represents the supply of a product. Many of these bids and offers come from cash market participants<sup>18</sup>.

Another terminology commonly used in futures markets is “short” and “long”. By short it is meant the seller, and by long the buyer. In the live cattle future market, the “potential short hedgers” usually are cattle ranchers, packers, processing industries, veterinary inputs, factories of machines and specialized tools, exporters and food related businesses holding inventory. The “potential long hedgers” include packers, importers, restaurants and food processors.

## **Theoretical issues about pure financial settlement of agricultural contracts (and the possible problems faced)**

A futures contract is a standard agreement between two parties, that obliges one party to sell and the other to buy a certain quantity and quality of live cattle at a given price, at or before a certain date in the future. Exchanges, in gene-

*17 The futures market speculator usually does not hold or plan to acquire the cash product. Speculators are a key figure in the futures market. They provide a major benefit to hedgers and the market as a whole, since they make possible the match between supply and demand. As a result, the market benefits by having market liquidity. In accordance with CME, “Market liquidity is a measure of the market’s efficiency, and it is this efficiency that results in better bids and offers for all market participants, including the hedger. Liquidity is also key to the ability to initiate and offset futures positions”. See CME, *Live Stock Self Study Guide*, 2013.*

*18 Cash market participants often use the futures contract price as a reference mark to transact in the spot (current) market.*

ral, follow basic rules about margins of guarantee and daily adjustments of payment settlements for the contracts, due to daily changes in prices from the starting day of negotiation to the expiration date of the contract.

The key word for a contract is standardization. All the conditions under which the live cattle are transferred from seller to buyer are established by the exchange before the transaction begins. The only thing left for the parties to trade and fix is the future price.

Everything else is organized and set by the exchange under certain standards. It is very important that no ambiguity exists, and that all the items and conditions are understood and agreed by the parties involved in the negotiation of the contract. Contracts, in general, have several pages and long lists of details.

In the actual operation of the agricultural markets, most futures contracts traded will never result in actual delivery of the physical commodity. The great majority of futures contracts will be “offset” or “closed out” prior to delivery by taking an opposite position in the same contract and delivery month<sup>19</sup>.

Therefore, the primary purpose of a futures contract is price risk management and not delivery of the actual or physical commodity on the futures contract. As such, it is usually more feasible in economic terms to deliver or accept delivery in a local cash market. Physical delivery on a Live Cattle futures contract is normally less than 1% of the total futures volume.

Then, why is there a physical delivery requirement on a futures contract? There are

*19 As mentioned by CME, “In other words, if someone initially buys a futures contract for a specific product and delivery month, and later sells a futures contract for the same product and delivery month, their position and market obligation is closed out. Conversely, if someone initially sells a futures contract and later buys back the same contract, the market obligation is closed out”.*

many possible answers. The most common says that there is a belief that it is the possibility of physical delivery that causes the cash and the futures markets to converge at contract expiration. According to this view, it also contributes to the necessary and vital market economic function known as price correlation, which keeps the cash and futures markets' prices moving in the same direction throughout the life of the futures contract. There is a common belief that for live cattle futures contracts, as seen in CME rules, a physical delivery is needed.

Using the CME as the benchmark, we can notice that, in the actual operation of the livestock market in the United States, CME makes a distinction between live cattle and feeder lot cattle. According with the CME, the Live Cattle futures contract requires settlement by means of physical delivery<sup>20</sup>. The Feeder Cattle and Lean Hog futures contracts traded at CME are cash (or "financially") settled contracts. In that Exchange, all outstanding future contracts of feeder cattle and lean hog that remain open after the last trading day are automatically closed out at a price set equal to the CME Feeder Cattle Index or the CME Lean Hog Index of the last trading day. This final cash settlement cancels the obligation of the buyer and the seller<sup>21</sup>.

The CME Rulebook dictates the specific standards in terms of the quantity and quality (USDA Grades) of cattle that can be delivered. The seller of the Live Cattle futures contract makes the final decision regarding the actual quality and quantity that will ultimately be delivered, but it must be within the standards authorized by the Exchange. Any variations to the standardized quantity or quality may be subject

<sup>20</sup> The CME's Live Cattle futures contract requires delivery of live cattle during the contract month for all market participants who still have an open long position (obligations to accept physical delivery) or short position (obligation to make physical delivery) based on the latest Exchange rules and regulations.

<sup>21</sup> The specific details of the cash-settlement process are presented on CME Rulebook at [cmegroup.com/rulebook](http://cmegroup.com/rulebook).

to premiums or discounts to the futures price<sup>22</sup>.

As previously mentioned, the CME's Feeder Cattle and Lean Hog futures contracts have a cash settlement requirement. Although it is a different type of delivery system than Live Cattle, the objectives are the same: cash/futures convergence and correlation. In the cash-settlement procedures, all long contracts still open after the last trading day are automatically offset against all remaining open short contracts. They are settled to a price equal to the CME Feeder Cattle Index or to the CME Lean Hog Index on that day.

Thus, there are two possible types of settlement for futures contracts: physical delivery and cash-settlement. At the bottom line, and if we adopt a more theoretical approach, we can conclude that it is the difficulty of the storage of the live cattle commodity – as compared, for instance, with the storage of grains – which supports the view that rules out pure financial settlement.

Thomas A. Hieronymus (1971) is one of the early and most important authors on the subject of economics of futures trading. In several passages of his work on the economics of futures markets he makes the point that, since it cannot be stored and suffers the risk of becoming a perishable commodity (in the commercial sense), live cattle futures contracts need physical delivery in order to have convergence of cash and futures prices. The following remarks he made can illustrate the point:

Cattle has a high degree of perishability (p.21);

Some commodities, like cattle...are not storable (p.41);

<sup>22</sup> The specific details of the physical delivery requirements specified in the CME Rulebook can be found at [cmegroup.com/rulebook](http://cmegroup.com/rulebook).

The delivery provision and the fact that deliveries are made and taken forces the trade in, and the prices of futures contracts to conform to the real world of cash commodity transactions (p. 41/42);

It was generally accepted that only those commodities with a high degree of storability were eligible for trading in futures markets. But this changed with the advent of trading in live cattle... (p.145);

The pricing of an yet unproduced product [such as live cattle] has an added dimension...futures prices become supply determining as well as supply rationing (p. 145);

The essential characteristic of price relationships in futures markets for non-storable commodities is that there is no functional relationship. The price of each delivery period is a true forecast of the equilibrium price that will prevail at that future time (p. 166);

The first of the strictly non-storable commodities traded was live cattle. At the outset traders were confused about the price relationships that should exist. Bound by tradition, they looked for a crop year and a carrying charge structure (p. 167);

Who would hedge in a non-carry market? It became quickly apparent that to buy the more distant months because a proper futures market should have a carrying charge was a nearly certain way to lose money (p.167);

Being artists at survival, the traders quickly modified this notion and started looking at potential changes in market supplies and consumer demand that might result in change in the current market price by the time of contract maturity (p. 167).

In another part of his work, Hieronymus states what, in my view, summarizes the challenges any exchange faces when trying to consolidate a new futures contract in the market: "... futures markets are fragile things; many are started and fail, many more fail to grow to viable size, and even the best are small in comparison to the jobs that need to be done" (HIERONYMUS, 1973, 339).

### **The author then continues:**

One of the most difficult tasks in starting and operating a futures market is establishing the terms for delivery. A futures contract is a temporary substitute for an eventual cash transaction. In markets that work, delivery is rarely made and taken; futures contracts are entered into for reasons other than exchange of title. Markets where there is a large amount of delivery fail and go out of existence because extensive delivery is an indication of an out of balance contract, one that favors either the longs or the shorts. When a contract is out of balance the disadvantaged side ceases trading and the contract disappears. (HIERONYMUS, 1973, 340).

Finally, Hieronymus states a lesson of wisdom, coming from someone possessed with both economic analytical and practical job skills, that goes to the heart of the subject, and inspired BM&F Bovespa to design the live cattle futures contract:

The objective in writing a futures contract is to obtain such even balance that only an amount to test the price – to keep it honest – is delivered; to make the contract so readily deliverable and receivable that there is no incentive to make or take delivery. The terms of the contract must be precisely representative of the commercial trading practices of the commodity. When contracts are written their terms are as closely descriptive of existing practices as a committee of knowledgeable people can make them. The commercial circumstances surrounding a commodity change as the production,

marketing, processing, and consumption change. The delivery terms appropriate at one time are not appropriate at another so that changes, sometimes frequent ones, are necessary. (HIERONYMUS, 1973, 340).

When attempting, in Brazil, to develop the futures and option contracts for live cattle in the 1990s, settlement through physical delivery became a real issue. At that time, there was a belief that it would be very challenging to organize purely financial settlement for live cattle future contracts. The theoretical issues behind this assessment were the ones outlined by Hieronymus: the equilibrium futures price for a non-storable commodity.

Brazil's derivative exchange, however, was able to do that, using a Price Indicator, that has been used for the last twenty years, calculated by ESALQ/USP (the leading University in Latin America), under contract with BM&F Bovespa<sup>23</sup>. As will be shown in the following section, the task was to calculate a price indicator that would obtain an even balance that did not favor either the longs or the shorts.

## Concept and creation of the Price Indicator

During the first years of the 1990s, Brazil was facing economic stagnation and high and accelerating inflation<sup>24</sup>. Although the economic scenario was not appropriate for the creation of exchanges offering price futures mechanisms, the stockbrokers decided to organize the first derivatives exchange, based in the state of São Paulo. Since the beginning, the BM&F Bovespa showed innovation with the development of the

<sup>23</sup> At the time of the creation of the price indicator, I was a part time professor of Economics at Esalq/USP and the Director for Agricultural Futures Markets of the BM&F Exchange. I acted in both capacities as member of the team designing the Price Indicator.

<sup>24</sup> Annual inflation rates were 1476.7% in 1990, 480.2% in 1991, 1157.8% in 1992, 2708.2% in 1993, and 1093.9% in 1994. In the following years, after the successful stabilization Plan (Plan Real), inflation rates became less than one-digit per year. GDP growth rates were (-4.45%) in 1990, 1.03% in 1991, 0.54% in 1992, 4.92% in 1993, 5.95% in 1994 and 4.22% in 1995.

futures and options markets.

Agricultural markets became an early target for the BM&F Bovespa business portfolio. The cattle market was an obvious target, but geographical distances and a small number of sellers and buyers created difficulties for delivery and physical settlement of futures contracts. Several attempts were made to organize a live cattle futures market for trade in the exchange, based on specific delivery points, but all failed to provide sufficient trade and liquidity.

This negative scenario created a dilemma for the exchange administrators. On one hand, all prevailing theory pointed to the need for physical delivery of live cattle. On the other, the delivery system was not working. Since the market was small, sellers and buyers employed opportunistic behavior to turn the conditions to their favor (even approaching situations of "black-mail").

For instance, a seller, unhappy with outcome of prices in the futures market, would chose, instead of financial offsetting, to use the delivery rules of the contract in order to oblige the buyer to receive live cattle in several different (and distant) locations (BM&F Bovespa had five delivery points). The purpose was to force the buyer into negotiation and increase the prices received by the seller.

Market participants, as a result, were afraid of entering the market, and the "live cattle" market failed to enter into take-off for sustainable growth. In the derivatives markets, the successful futures markets are liquid, since liquidity is essential to success. In that context, trading tends to be in large volume. Thus, the challenge for BM&F Bovespa was to turn the live cattle contract into a liquid and high volume trading mechanism in the market.



In order to develop the live cattle future contract, the exchange administration decided to innovate, by resorting to the use of pure financial settlement for futures contracts<sup>25</sup>. For this purpose, the exchange would need a price indicator, which would be fair and reliable. BM&F hired the University of São Paulo (EASLQ/Cepea) to calculate a daily index of price (based on buyers and sellers) for use in the clearing and settlement of the contracts. In addition, the price indicator should be capable, through negative or positive premia, to be representative of live cattle prices in the whole country.

CEPEA was created in 1982, as part of the Department of Economy, Administration and Rural Sociology of ESALQ/USP. The mission of CEPEA is to identify the demands arising from society and the economy, and to create a channel between business and the academic activities and research of ESALQ.

Given its reputation as a strong educational unit, BM&F Bovespa chose CEPEA to be responsible for the Live Cattle Price Indicator. The first agreement was signed in 1993, and the “Indicador de Preço do Boi Gordo” has been in place for the last 20 years. It shows an impressive track record, and, very uncommon in developing countries, without episodes of scandal or corruption that could tarnish the reliability of financial settlement of futures contracts using the price indicator.

Since its creation, it has published 5,000 daily price reports containing the price indicator. There are 14 people working full time in the team responsible for the price indicator. On average,

each member of the team gets into personal contact with 70 respondents daily, representing the major forces of supply and demand in the market. In addition, there are 1,500 electronic calls per day, for both buyers and sellers.

Every business day Cepea inquires the price the buyer paid, and the price the seller sold the “arroba” of meat. After so many years of daily interaction between the Cepea team and the respondents, there is already a strong element of trust involved, which helps the governance of the price indicator. The purpose is to obtain a balanced indicator for live cattle prices, making it possible to weigh fairly demand and supply intentions and behaviors, replicating the shifting supply and demand curves of the market for this commodity.

The price Indicator is used for financial settlement of all future contracts of live cattle traded in the Exchange. In addition, the financial support obtained in the process made possible the creation of a whole research area in the field of economics of the meat industry in Brazil.

## Methodology used for the price indicator

Cepea used the following methodology and criteria in order to develop the ESALQ/BM&FBovespa Index for Live Cattle:

1) Fed cattle prices are collected in four regions of São Paulo state: Presidente Prudente, Araçatuba, Bauru/Marília and São José do Rio Preto;

2) The importance of each region in the composition of the Index is defined according to the slaughter volume of the contacted slaughterhouses – updated monthly. The participation of each region is defined by summing up the slaughter volumes in the units that are registered

25 For precaution, however, BM&F decided in the beginning months to keep a possibility for physical delivery. Although discouraging this modality of settlement, BM&F acquired and managed a cattle corral facility, located in Araçatuba, a strong cattle and ranch market in the state of São Paulo (Southeast region of Brazil), for sellers to deliver the trucks with cattle, if they desired to do so. After a few months, with the consolidation of financial settlement of future contracts, the corral facility was closed.

by the Federal Inspection Service – SIF;

3) When any unit is excluded from the sample, due to the lack of price information or for statistical criteria, the related importance of that unit is distributed among the others. Given that, the weighted system can be different every day, according to the share of each slaughterhouse in the sample.

From January/2012 onwards, the ESALQ/BM&Fbovespa Index is ceased including Funnrural tax (2.3%). With respect to traceability, the prices composing the sample should respect an interval of two standard deviations. For tracked animals, prices that are out of that interval are excluded from the Index calculation. Prices which are within that interval are considered for tracked or non-tracked animals, since there is no official premiums for the tracked animal. It is impossible to exclude or include information by other criterion that is not a statistical one, defined in the methodology.

For the other regions, prices are also collected in the states of Mato Grosso do Sul, Goiás, Mato Grosso, Pará, Rondônia, Rio Grande do Sul, regions of Triângulo Mineiro and the northwest of Paraná, besides the wholesale market of São Paulo. With respect to animals for replacement, Cepea also collects, since March 1994, prices of calf, feeder cattle, heifer and cows, classifying these animals by race and age. Meeting the main demand of the market, Cepea publishes every day, from 6:00 p.m. onwards (Brasilia time), prices of nelores calves, from 8 to 12 months.

### **Elasticity of Transmission of ESALQ/BM&F Price Indicator from São Paulo to other cattle regions in Brazil**

The purpose of this analysis is to

identify the intensity of price transmission of the Financial Indicator of Live Cattle BovespaBMF to the main locations and regions of cattle ranches/meat producers in Brazil.

We analyzed six locations/regions<sup>26</sup> and the Live Cattle Price Indicator. The locations/regions studied were Três Lagoas (MS), Campo Grande (MS), Triângulo Mineiro (MG), Goiânia (GO), Rio Verde (GO) and Cuiabá (MT). We used the daily prices of the State of São Paulo Live Cattle Indicator – Cepea/BovespaBMF during the period January 2005 to February 2014.

In order to analyze the relationship among the economic variables, we will use the concept of price transmission elasticity. This concept is similar to any other concept of elasticity. The traditional concept of price elasticity of demand shows how variation of prices of a given product can cause changes in the respective quantity demanded. The concept of elasticity of transmission of prices shows how changes of prices of a product in a specific market are transmitted to the prices of the same product within the same market, although, in another level or, then, how variation of prices of a specific product are transmitted for the prices of the same product in another market.

According to Barros and Burnquist (1987), the definition of the elasticity of vertical transmission of prices “deals with the relative variation in the price at a Market level with respect to the variation in the price at another level, keeping in equilibrium these two levels of market after the initial shock in one of them. The elasticity of price transmission between two markets vertically integrated may be defined as the percentage change of prices of a given good in a Market, resulting from a 1% change

<sup>26</sup> Called in Portuguese language *praças/regions*.

in the price of this good in the other Market. In algebraic terms, it could be represented in the following way:

$$\eta_{pv} = \frac{\frac{\delta P_v}{P_v}}{\frac{\delta P_p}{P_p}}$$

In which:

$\eta_{pv}$  = elasticity of transmission of prices between the Indicator/region;

$\delta P_v$  = change of the price in the region;

$\delta P_p$  = change of the price in the Indicator;

$P_v$  = price of the good in the region;

$P_p$  = price of the good in the Indicator.

If  $\eta_{pv}$  is greater than one, it means that the percentage changes in the prices of the region will be greater than the percentage changes of the Indicator Bovespa/BM&F. If  $\eta_{pv}$  is smaller than one, the percentage changes of prices will be smaller for the region and if  $\eta_{pv}$  is equal to one, the percentage changes will be equal in the two levels.

The analysis of the elasticity of price transmission involves, basically, the daily time series of the Live Cattle Indicator Bovespa/BM&F, and the daily prices obtained from the main producing regions, and can be shown using the equation below. The equation is obtained from the co-integration model, based on the coefficients  $b_1$ , which give the value of the price elasticity of transmission between BM&F and all the other locations pertaining to the Indicator:

$$Pr_t^i = \beta_0 + \beta_1 Pr_t^j + v_t$$

In which:

$Pr_t^i$ : price of live cattle during period “t” in region “i”;

$Pr_t^j$ : price of live cattle during period “t” in region “j”;

$\beta_0, \beta_1$ : parameters;

$v_t$ : random error (White noise)

**Table 1 – Estimatives of the Coefficients of the Price Transmission Elasticity between the variable “Live Cattle Indicator” (Ind) and the other regions: Campo Grande (CG), Três Lagoas (TL), Goiânia (GO), Rio Verde (RV), Cuiabá (CB) e Triângulo Mineiro (TM).**

Variables	Coefficients	Significance	Elasticity*
Campo Grande			
Lind	0,52	0,00	0,52
Lind(1)	0,58	0,00	1,11
Lind(2)	-1,22	0,00	-0,11
LCG	-1,00	0,00	
Três Lagoas			
Lind	0,97	0,00	0,97
Lind(1)	-0,07	0,50	0,90
Lind(2)	0,02	0,45	0,93
LTL	0,07	0,48	
Goiânia			
Lind	0,99	0,00	0,99
Lind(1)	0,05	0,59	1,04
Lind(2)	0,08	0,09	1,12
LTGO	0,02	0,86	
Rio Verde			
Lind	1,03	0,00	1,03
Lind(1)	-0,15	0,15	0,89
Lind(2)	0,05	0,10	0,94
LRV	0,14	0,14	
Cuiabá			
Lind	0,94	0,00	0,94
Lind(1)	-0,12	0,25	0,83
Lind(2)	0,04	0,38	0,86
LCB	0,12	0,23	
Triângulo Mineiro			
Lind	0,96	0,00	0,96
Lind(1)	-0,15	0,13	0,81
Lind(2)	0,03	0,42	0,83
LTM	0,17	0,09	

Source: Author

\*0,52=Lind; 1,11= Lind + Lind(1); -0,11= Lind + lind(1) + Lind(2)

We show in Table 1 the results obtained with the use of the co-integration model. We can see the elasticity coefficients of the indicator with respect to each region, in a three days period, as well as the significance level of each variable. The prices included in the Bovespa/BMF Price Indicator are the independent variables and the prices earned by the cattle ranchers from the different market locations are the dependent variables.

We can see that the results were significant for all regions, showing that there is a positive transmission of prices of the Cepea/Bovespa-BMF towards the most important live cattle producing regions in Brazil, with high coefficients.

### **Evaluation of the usefulness of the price indicator as a tool for futures markets**

All the markets/regions under study show good regression coefficients ( $\beta_1$ ), principally the regions of the states of Goiás, Goiânia and Rio Verde, showing the highest coefficients with greater intensity in the transmission of prices in the same day of the Indicator (Lind). Since the price transmission at the same day is difficult to be verified, we analyze the intensity of elasticity in the next day or in the sum of three days.

If we analyze the price in Campo Grande, we can see higher intensity in the following day, with an elasticity of 1.11 (Lind + Lind(1)). In other words, for a variation of 1% of the Live Cattle “arroba” in the Bovespa/BM&F Indicator, the price in this particular region will vary in 1.11%. We can notice that for Campo Grande the coefficients were significant in all days.

In the other five regions (Três Lagoas, Goiânia, Rio Verde, Cuiabá and Triângulo Mineiro) the higher intensity takes place from the second to the third day, and the highest

coefficient was shown in Goiânia, 1.12 and the smallest in the Triângulo Mineiro, 0.83, showing an increase of 0.83% when the indicator rose, two days earlier.

Finally, the results of price transmission for live cattle (indicator for all regions), taken as a whole, point to a strong transmission between Bovespa BMF and the Market locations/regions that were examined. We can also notice that the intensity is very near one in all regions, and in some cases even surpassing one. Based on that, we conclude that the more organized are the market locations and their regional localizations, the higher is the intensity of price transmission. Another important factor is the signaling that the live cattle market in Brazil has assimilated the idea that a financial indicator is a reliable price that can reduce uncertainty and information costs for the participants of this market in places other than the designated delivery points.

### **Importance of the Price Indicator:**

First, it is a very important financial innovation. At the time we designed the price indicator, it was considered impossible to settle agricultural futures contracts only financially, since it was common sense to include the need for physical delivery during the days approaching the settlement day. After 20 years, the pure price indicator for financial settlement works properly.

Second, Brazil, like the US, has continental dimensions, the climate (from North to South) is equatorial in the north, tropical in the middle, temperate in the South. Our cattle is both from genetic India and Europe, so it is a challenge to organize a price indicator for different varieties of meat, and to find prices representative of the several producing regions.

Third, it is an institutional innovation too, since the price indicator was conceived

and begun to operate during the time of hyper inflation in the country, followed, in the last 19 years, by a one digit annual inflation in the country<sup>27</sup>. The price indicator is also a good example (rare in Brazil) of University/Private Sector cooperation.

Fourth, the price indicator contributed to the development of a modern cattle/beef activity in Brazil. Thus, is a very good example of an innovation in the financial sector, which can contribute for the advancement of the real sector of the economy.

## Conclusions/Importance of modern futures markets for Brazil

In a world of increasing volatility, the Brazilian economy, highly dependent on export of agricultural and mineral commodities, needs to manage risk across several major asset classes – mainly agricultural commodities, interest rates, and foreign exchange.

The derivatives exchange, BM&F Bovespa, is providing the tools customers need to

*27 There was another innovation about the live cattle contract, dealing more with regulatory issues. It happened when I was director of BM&F Bovespa, trying to organize a live cattle future market. Brazil was experiencing, in the beginning 1990s, a continuation of the hyperinflation of the 1980s. The country had had several plans to end inflation, but without success. Inflation, by the time I was trying to organize the market, was reaching from 30 to 50% a month! Imagine how complicated it was to organize a hedging market against price volatility in a scenario of hyperinflation! Strange as we may think, there was demand for that instrument. Live cattle, raised in pasture, has short and long cycles of prices, depending on rain and real meat and milk prices (that affect the size of the herd). Brazil is the largest cattle country of the world, with more than 200 million animals. Both buyers and sellers of the meat chain business needed such hedging instrument. We decided to create the market...using the US dollar. Cattle ranchers were already using the dollar as the reference, but settling the purchase and sale using the Brazilian currency. The problem was that the Brazilian law prohibits the use of a foreign currency in domestic contracts. We had in our team a "brilliant" idea: to have the contracts referred in "base points". The future prices would be set in "base points"! The existing Civil Law did not have any provision prohibiting the use of "base points". In addition, there was a conversion procedure regulating that prices would be translated from "base points" to the Brazilian currency, in accordance with the closing quotation of the official exchange rate with the dollar. It worked, and the live cattle market was able to flourish. The interesting point in the story was that the Central Bank of course knew what we were doing, but pretended nothing was happening. It is an example of "don't ask, don't tell". If BM&F Bovespa would ask for permission, the Central Bank would have to deny it. Since there was no formal request, ordinary business followed.*

meet business objectives and achieve financial goals. The live cattle futures market, traded on the exchange, assures that the cattle businesses can substantially mitigate counterparty credit risk, by offering liquidity, transparent pricing, and equal access for all participants.

Beef cattle is one of the important business areas. We attempted in this paper to make an evaluation of the usefulness of the price indicator as a tool for futures markets, and to evaluate the role played by it in the active trade of live cattle contracts in the country. Finally, we discuss the importance of modern futures markets for a country like Brazil, possessing strong comparative advantages in natural resources/agriculture/mining, but needing to develop competitive advantages in commerce and the production of commodities.

The world experience shows that several commodities and financial instruments are possible to be negotiated through the futures market. There are no precise formulas to indicate ex ante which commodities or financial instruments will succeed. The exchanges, after undergoing the huge investments for the building, trading pits, advertisement, organization, clearing houses, and other areas, have considerable economies of scope for launching new contracts.

The big problem, however, is not how to design a new contract. The real problem is how to acquire liquidity, how to have a substantial number of hedgers and speculators engaged in daily negotiations. The development of live cattle futures market is a case study on how to create a trade environment.

To conclude, this paper is part of my field of research, which studies the external macroeconomic and institutional factors, and the internal factors of the architectural organization and

the decision making process of the derivatives exchange in Brazil, with the focus on the causes of the growth and decay of trading in futures and options contracts across the different markets.

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